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Comparative Analysis of Produced Organic Soap from Garlic Juice-Benni-Seed Stalk Ash Extract and Coconut Oil and Some Selected Commercial Soaps

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ABSTRACT

Comparative Analysis of Organic Soap Produced from Garlic Juice-Benni-Seed Stalk Ash Extract and Coconut Oil and some Selected Commercial Soaps. The method used involved Collection of Benni-seed stalk and preparation of Alkali, Collection and Extraction of Coconut Oil, Collection of Garlic Bulb and Preparation of the Garlic Juice- based Alkaline. The produced soap was characterized based on physical characteristics (Soap Types, Colour, Texture, Aroma and Cleaning efficiency), pH of the soap samples, Foaming Stability, water hardness Test and Wash Fastness Properties Test. The result of the study shows that variation occurred among soap types as a result of addition of colouring matter such as dyes and degree of unsaturation of fatty acids. The pH of all the soaps falls within the range pH of (7-8) improving soaps quality but to regulate the pH level which will not contribute to the harshness of hands and skin. In terms of foaming stability, result obtained from GBC Soap was the best due to its solubility in water. Analysis of Soap hardness in soft water and hard water shows that Bright Soap had the highest value (8.5) in soft water which made it the best among other soap products. Premier Soap had the best ability to maintain the quality of fabric material when washed in water.

Keywords: Alkali; Benni-seed; Coconut oil; Garlic; Natural organic soap.

Introduction

Oforghor *et al.* (2020) reported that cleanliness is a very important thing due to the increasing number of diseases caused by bacteria and germs. Soap is a substance used with water for washing and cleaning, made of a compound of natural oils or fats with sodium hydroxide or another natural alkali, and typically having perfume and coloring added (Kurian, 2007). Even today, soap is not just used for cleaning to maintain the health of the skins; there are also some soaps that also serve as softening soap and whitening soap. In making soap often used various kinds of fats or oils as raw material. For being used in soap manufacture the type of oil needs to be selected in accordance with the use of soap itself. Based on the making process, soap is made in two ways, namely saponification process and oil neutralization process (Gough, 1999).

Saponification process occurs because the reaction between triglycerides with alkali, while the neutralization process occurs due to free fatty acid reaction with alkali (Loden, 2014). Oil saponification process will obtain by-product namely glycerol, while neutralization process could not get any glycerol. Along with the advancement of the era, they also developed a kind of soap that circulates in the market. Bath soap that circulates in the market based on its shape is divided into two forms, namely solid soap and liquid soap (Kathy, 2009). Solid soap itself is divided into several types based on their appearance, i.e., opaque soap (non-transparent solid soap), and translucent soap (solid soap with almost transparent color), and transparent soap (solid soap with transparent color) (Kara, 2007).

Badan (2016) stated that there are two main components of soap constituents which are fatty acids and alkali. Selection of the type of fatty acids determines the characteristics of the resulting soap, because each type of fatty acids will give different properties to the soap. Fatty acids are the main components of fat and oil composites, so the

selection of the type of oil to be used as a raw material for making soap is very important. To produce soap with good quality, it must use raw materials with good quality too (*Foale, 2003).*

Cavitch (2004) reported that the excess of soap made from coconut oil compared to other oils is that coconut oil soap has a good cleaning power due to the presence of lauric acid as the dominant fatty acids in coconut oil. The addition of other ingredients as a mixture in paper soap making can also maximize the benefits of the paper soap used. One of the ingredients of the mixture used as a reference treatment in the process of making paper soap is glycerine. Based on experiments that have been done, glycerin as a plasticizer can make soap become elastic in texture such as industrial paper soap products (Karty, 2009).

Boueke and Harwood (2009) reported that to know the best glycerine concentration, proper formulation, and quality of resulting from paper soap, it is necessary to do this research. Until now there has been no research on making coconut oil-based paper soap and using the concentration of glycerine as a treatment. So, there is no provision regarding soap formulation of palm oil-based paper and how the printing soap process. The purpose of making paper soap is expected to produce soap paper that can be used every day whenever and wherever, and able to cause a sense of comfort on the skin and able to prevent the skin from infections caused by bacteria (Buchan, 2010).

Foale (2003) reported that black soap has both medicinal and cosmetic benefits. It has been known that black soap Soothe skin irritations and diseases from simple rashes to contact dermatitis and psoriasis, Helps in treating fading skin discolorations, Evens out skin tone, It can be used for solving body odour situations.

Kurian (2007) opined that Benni-seed, or Sesame Seed as it is sometimes referred to, is an annual flowering plant which is cultivated for its seeds, grows in pods and is believed to be the oldest cultivated oilseed in the world. Although with a doubtful origin, it is widely believed to have originated from Africa. Sesame is often called by different names based on the location, some of its common names are Benniseed, Gingilly, Simsim, Tahini, and Til (*Kurian, 2007).* Sesame was introduced to Nigeria after the Second World War and was mostly cultivated as a minor crop in the Northern and Central part of Nigeria until 1974 when it began to gain prominence as a major cash crop. Although sesame cultivation is on the increase in terms of areas cultivated, its full potential is yet to be explored in Nigeria due to lack of local farmers adherence to best farm practices suitable to its growth (*Engeland, 2007).* Sesame ranks eighth in the world production of edible oil seeds, with higher oil content than other oilseed crops. It is grown mainly for its seeds which contain approximately 50% oil and 25% protein. The presence of some antioxidants (sesamum, sesamolin, and sesamol) makes the oil one of the most stable vegetable oils in the world. In addition to having high oil content, Sesame seed is known for its nutritional and medicinal qualities. The seed contains all essential amino acids and fatty acids and it is a good source of vitamins (pantothenic acid and vitamin E) and minerals such as calcium (1450 mg/100g) and phosphorous (570 mg/100g) (*Kurian, 2007).*

Engeland (2007) reported that Garlic (*Allium sativum*) is a hardy perennial member of the onion family. The name *garlic* comes from the Welsh word *garlleg,* which is transformed into the English word *garlic.* Garlic is probably native to Central Asia but has long been naturalized in southern Europe and throughout the world. Garlic (*Allium sativum*) differs from the onion (*Allium cepa*), producing a number of small bulbs called *cloves* rather than one large bulb. Each bulb contains a dozen or more cloves covered with a thin white skin. Each clove is made of

two modified mature leaves around an axis with a vegetative growing point. The outer leaf is a dry sheath, while the base of the inner leaf is thickened, making up the bulk of the clove. The larger outer cloves produce the best garlic. Garlic has excellent benefits for skin such as Reduce Acne, Soothes Psoriasis, Delay Aging, Fade Stretch Marks, Soothe Eczema, and Prevent Hair Loss.

Marseden (2009) reported that coconut tree (*Cocos nucifera*) is a member of the palm tree family (Arecaceae) and the only known living species of the genus *Cocos*. The term "coconut" (or the archaic "cocoanut") can refer to the whole coconut palm, the seed, or the fruit, which botanically is a drupe, not a nut. The term is derived from the 16th century Portuguese and Spanish word *coco*, meaning 'head' or 'skull' after the three indentations on the coconut shell that resemble facial features.

Coconuts are known for their versatility of uses, ranging from food to cosmetics. The inner flesh of the mature seed, as well as the coconut milk extracted from it, forms a regular part of the diets of many people in the tropics and subtropics. Coconuts are distinct from other fruits because their endosperm contains a large quantity of clear liquid, called coconut water or coconut juice. About 74% of the world's supply of coconuts derives from Indonesia, the Philippines, and India combined (Grimwood, 2003).

Foster (2009) opined that the Benefits of Coconut Oil to the Skin include Kill Harmful Microorganisms, Treatment of Acne, Moisturizes Dry Skin, Wound Healing. Oforghor (2022) reported that the characteristics of soap produced from coconut oil. The kind of foam produced by soap from coconut oil is incredibly creamy, the soap is hard with fluffy leather. The texture of the soap is ideal and moisturizing. The effect of the soap on the skin is that it smoothens and softens the skin. It is also good for dry and sensitive skin because coconut oil is a fantastic emollient (an agent that softens or smoothens the skin).

Methodology

Design of the Study

The study adopted an experimental design method and the experimental work was carried out at the laboratory of the Faculty of Agriculture, Shabu-Lafia Campus, Nasarawa State University, Keffi.

Materials and Equipment that were used

Materials

Benni-seed stalk ash, oil (coconut oil) and garlic bulb, Measuring cylinder, Distilled water, Heat source, Stirrer, Weighing scale, Bowl, Pan.

Precautions followed while mixing the ingredients

It is important to have protective cover when producing soap.

- Wear protective cloths such as lab coat or overall jacket.
- Protect your face with face mask.
- Wear hand gloves.
- Wear safety boot.

Methods

Collection of Benni-seed stalk

The benni-seed stalk was collected from Shaste village in Kadarko, Giza Development Area. The benni seed stalk was burnt to ashes and the ash was sieved and kept in plastic container. The ashes were taken to the laboratory for weighing.

Collection and Extraction of Coconut Oil

The coconut seeds were purchased from Agyaragu Market Jenkwe Development Area. The coconut seed pulp was cracked open and steeped in water for 30 minutes for easy removed of the pulp from the hard pericarp. After which the pulps were removed and cut into pieces.

The cut pulps were taken to a grinding machine where the pulps were grounded into a pulp paste. The paste was then sieved to remove the chaff, the filtrate was subjected to the heat source to obtain pure coconut oil.

Collection of Garlic Bulb

The garlic bulb was purchased from the Modern Market in Lafia Local Government Area. The garlic bulb was peeled and cut into pieces for opening of the bulb cover. The garlic was grated and the grated garlic was dried for 72 hours after which it was pounded using mortar and pestle into powdered form.

Five (5) litres of water was added to 50g of the garlic powder and kept for 72 hours, which was then filtered and stored in an air-tight plastic container.

Preparation of the Garlic Juice- based Alkaline

1kg of the benni-seed stalk ash was poured into a perforated bowl containing a sack and 5 litres of the garlic juice was added to it. The content was placed on a stand and a collection bowl was placed under neat to the alkaline. This was done for six days for proper filtration.

Steps followed in the Production of Organic Soap (Saponification)

i. Set a fire and place a stainless pot on it

ii. 600ml of coconut oil was poured into a pot

iii. Two litres of Alkali was added to the mixture

iv. The mixture was allowed to boil for saponification to take place with continuous stirring.

v. The soap was poured into a rubber to obtain a round shape

vi. The soap was named GBC and was then packaged

The produced soap was characterized based on the following:

Soap types, Colour, aroma, texture and cleaning property

These properties colour, texture, aroma and cleaning property were physically observed on the produced soaps and the commercial soaps. The result is shown in Table 1.

pH of the produced organic soap

1% stock concentration of the soap was prepared. The mixture was stirred to obtain homogenous solution. pH meter was used to measure the pH of soap. This procedure was repeated for all the samples, (Oforghor, 2016) as showed in Table 2.

Foaming Test

1% stock concentration of the soap was prepared. The mixture was stirred to obtain homogenous solution. The foam height was measured by shaking the test tube until foam started foaming. The foam was allowed to stabilize. The height was measured using rule in centimeter (Oforghor, 2016).

Hard water test

1% stock concentration of the soap was prepared. The mixture was stirred to obtain homogenous solution. Then three drops of $CaCl_2$ and $FeCl_3$ were added to the two soap solutions and the content was agitated to form Foam. The test tubes were shaken in order to measure the height. This was compared to step (iii) which was done in soft water, the result is showed in Table 4.

Interaction with the oil test

1% stock concentration of the soap was prepared. The mixture was stirred to obtain homogenous solution. Then three drops of palm oil, palm kernel oil and coconut oil were added to the two soap solutions and the content was agitated to form Foam. The test tubes were shaken in order to measure the height. This was compared to step 3.4.3 which was carried out in soft water (Oforghor, 2021). The result is showed in Table 1.

Wash fastness test

1% stock concentration of the soap was prepared. The mixture was stirred to obtain homogenous solution. 2g of the soap was dissolved in 100ml of distilled water and stirred until a homogenous solution was obtained. 1g of the fabric was placed inside the soap solution and washed for 2 minutes. The fabric was rinsed and dried. This was repeated for all the samples. The washed samples where compared with the unwashed samples. The colour change for each wrappers where assessed using grey scale (Oforghor, 2021). The results are showed in Table 5.

Results and Discussions

Table 1 shows the physical characteristics of the different samples of soaps, results shows that GBC is a multipurpose soap for bathing and washing, Bright and Viva are Laundry/Toilet soap while Premier as Bar/Laundry soap. GBC soap indicated Black colour, Bright soap shows brown colour, Viva displays white colour while Premier pink. This variation occurred as a result of addition of colouring matter such as dyes and degree of unsaturation of fatty acids (Mabrouk, 2005 and Oforghor et al.; 2022). In terms of texture, GBC shows semi-solid while Bright, Viva soap and Premier are hard respectively. The firmness of soap product, varies in texture depends on the nature of fatty acids composition, length of hydrocarbon chain and nature of double bonds in the carboxylic acid portion of the fats or oil used (Abulstafa *et al.*, 1995 and Oforghor et al.; 2022). The result on Table 1 shows that GBC is Garlic-like in term of aroma, Bright soap had Caustic soda odour while both Viva and Premier had fragrance. Differences in colour could be the presence of perfume in the soap which is responsible for its

characteristic odour. The cleaning efficiency of the soap used in this study shows that all the soaps shows an excellent ability to clean on oil water (palm oil, palm kernel and coconut oil). This could be as a result of the addition of foreign material to the soaps (talc and rosin). These soaps have the ability to emulsify with oil and water to remove dirt easily because of their solubility in water. Soaps like Bright, Viva and Premier could contain washing powder which act as cleansing agent.

Table 1. Soap Types, Color, Texture, Aroma and Cleaning Property

Soap samples	**Soap Type**	**Color**	**Texture**	**Aroma**	**Cleaning Efficiency On Oily Water**		
					Palm oil	P.K.O	Coconut oil
GBC Soap	Multipurpose	Black	Semi solid	Garlic like	Excellent	excellent	Excellent
Bright Soap	Laundry/Toilet	Brown	Hard	Caustic soda	Excellent	Excellent	Excellent
Viva Soap	Laundry/Toilet	White	Hard	Fragrance	Excellent	Excellent	Excellent
Premier soap	Bar/Laundry	Pink	Hard	Fragrance	Good	Good	Good

Key: GBC (Black soap), Bright Soap, Viva soap, Premier Soap.

P.K.O. = Palm kernel oil

Table 2. pH of the soap samples

Samples of Soaps	**pH**
Control (DW)	7.0
GBC Soap	8.5
Bright Soap	8.9
Viva Soap	8.5
Premier Soap	7.8

Key: GBC (Black soap), Bright Soap, Viva soap, Premier Soap.

pH of the Soap samples

Table 2 shows that the pH value of Bright soap sample was the highest (8.9) followed by GBC and Viva which are (8.5) and (8.5) respectively, while Premier recorded the lowest pH. According to Oforghor *et al.* (2022) the pH values for any soap that falls within the range pH of (7-10) improve soap quality but regulate the pH level which shall not contribute to the harshness of hands and skin. For the purpose of protecting public health, high pH levels are between 9 to 11 range and low pH falls within 3 to 5 level which are considered deleterious to the skin. This is in accordance with NAFDAC regulatory requirements on cosmetics, soaps and detergents (Umar, 2002 and Oforghor *et al.,* 2022).

Table 3. Foaming Stability of the Soap prepared

Samples of Soaps	Height of Form over water (cm)
GBC Soap	8
Bright Soap	4
Viva Soap	6
Premier Soap	7

Key: GBC (Black soap), Bright Soap, Viva soap, Premier Soap.

Foaming Stability of the Soap

Result on Table 3, the foaming stability of different soaps shows that GBC had the highest (8cm) foaming stability followed by Premier Soap (7cm) while Bright soap had the lowest (4cm). GBC Soap foams scum or precipitate leaving rings around the test tube with whitish residue.

The result of the GBC Soap was the best due to its ability to be soluble in water. Reviews shows that soaps made from potassium produces finer lather which could be used independently or in combination with sodium soaps. This could be because GBC soap made from sesame stalk ash contains potassium which made it more soluble in water than Bright, Viva and Premier Soaps probably made from sodium.

Table 4. Hardness Test of the Soap prepared

Samples	Soft water	Hard water	
		$CaCl_2$	$FeCl_3$
GBC Soap	8.5	2.1	0.8
Bright Soap	8.9	1.3	0.0
Viva Soap	8.5	1.1	1.0
Premier Soap	7.8	2.1	0.0

Key: GBC (Black soap), Bright Soap, Viva soap, Premier Soap

Analysis of Soap hardness in soft water and hard water is presented in Table 4, result shows that Bright Soap had the highest value (8.5) in soft water as analyzed followed by GBC and Viva which had (8.5) and (8.5) respectively. The Bright soap forms scum or precipitate leaving rings around the test tube with whitish residue.

The result shows that Bright Soap was the best due to its ability to be soluble in soft water. The results of the form stability in hard water were very poor, this point to a serious defect in the soap to be used with hard water. Their reaction with $CaCl_2$ and $FeCl_3$ exhibited little foam which constitutes the hardness of the water affected by metal salt or acidic which leaves sticky curd in the rinse water (Robert, 2006).

Table 5. Wash Fastness Properties Test

Samples	W1	W2	W3	W4
GBC Soap	4	4	4	4
Bright Soap	4	4	4	4
Viva Soap	4	4	4	4
Premier Soap	5	5	5	5

Key: GBC (Black soap), Bright Soap, Viva soap, Premier Soap.

Wash Fastness Properties Test

The result on Table 5 shows that Bright Soap and Viva Soap show good colour rating and had high ability to retain the colour of fabric material which could be as a result of the presence of good bonding between the fabric and the colour (Oforghor et al.; 2022).

Conclusion

Based on the results obtained from the study, soap made from coconut oil compared to other oils has good cleaning power due to the presence of lauric acid as the dominant fatty acids in coconut oil. Garlic is a powerful antioxidant and antimicrobial properties. Any soap made from coconut oil and Garlic-like substances would be able to solve the problem concerning skin diseases. Results obtained from the study revealed that the Black (GBC) had good physical characteristics (Soap Types, Color, Texture, Aroma and Cleaning efficiency), pH, Foaming Stability, soft in water and had good washing fastness properties Test.

Recommendations

Based on the findings of the study, the following recommendations were made;

- Local materials should be used to produce black soap since they are cheaper, easy to source and highly economical in relation to that of industrial soap.

- Locally made soaps are recommended because of their remedy to skin health issues.

- More research should be carried out in the area of the soap's chemical properties (water content, insoluble material in ethanol, free alkali, and unsaponified fat) and also in the area of anti-microbial potency of the soap.

Declarations

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This study did not receive any grant from funding agencies in the public or not-for-profit sectors.

Competing Interests Statement

The authors have declared no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this study.

Authors' Contribution

All authors took part in literature review, research, and manuscript writing equally.

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